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STUDIES ON EFFECT OF GIBBERELLIC ACID AND NAPHTHALENE ACETIC ACID SPRAY ON FRUIT SET AND YIELD OF APRICOT (*PRUNUS ARMENIACA* L.)

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ABSTRACT

To know the response of apricot to plant growth regulators, a field experiment was conducted at the Fruit Orchard, Department of Fruit Science. V. C. S. G Uttarakhand University of Horticulture and Forestry, Bharsar, Uttarakhand during 2014-2015. The experiment was laid out in Randomized Complete Block Design (RCBD) comprised of nine treatments and three replications having various combinations of growth regulators (GA3 and NAA) applied at full bloom stage. Among all the treatments applied,'T5'{GA3 10ppm + NAA 10 ppm} performed best with highest fruit set (60.59%), fruit yield (26.33 kg), fruit size (2.14 cm × 2.61 cm length × diameter), fruit weight (22.33 g.), fruit volume (32.05 cm3/fruit), fruit firmness (1.26 kg/cm2), highest total soluble solids (21.00 0 Brix), titrable acidity (0.67%), ascorbic acid (13.45 mg/100 gram), total phenol (0.07 mg/100 gram), total sugar (21.22%), reducing sugar (4.27%) and non reducing sugar (16.11%).

KEYWORDS: Apricot, GA_3, NAA, Yield & Quality

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Original Article

INTRODUCTION

Apricot (*Prunus armeniaca* L.) belonging to family Rosaceous and sub family Prunoidae is one of the members of stone fruits and grown in temperate regions of the world, is one of the most important temperate fruit crops of northeast china region in India. It is liked throughout the world by all the people due to its pleasant taste and nutritional value. Uttarakhand is one of the important states of growing apricot. Plantations of known cultivars are rare and sparse in the state.

Apricot is considered by one of the most delicious temperate tree fruits. The fruit contains different levels of photochemical such as Vitamins, Carotenoids and Polyphenols, which contribute significantly to their taste, color and nutritive value. Generally, apricot fruit has great nutritional value because of fiber, minerals (K, Ca, Fe, Mg, Zn, P and Se) and low energy intake (50 Kcal 100 g-1 fresh weight) that combined with the nutraceutical plus-value (Vitamin C, A, Carotenoids, Phenols, Thiols, Thiamine, Riboflavin, Niacin and Pantothenic acid) make apricots 'healthy & easy-to-eat' (Leccese *et al.* 2011). It ranks second next to plum among the stone fruits in area, production and popularity in India.

Plant growth regulators PGRs (auxins, gibberellins, and cytokinins) are used in many fruit production systems to increase fruit size. Preharvest PGR applications that could improve fruit size, color, and precocity of apricot would

enhance their marketability. The improvement in the yield and quality of the crops, mainly depends on the concentration of plant growth regulator and time of application (Singh, 1995). Bio regulators have used for the improvement of quality and productivity of many fruit crops. Application of gibberellic acid (GA_3) naphthalene acetic acid (NAA), ethephon separately or in a mixture had a significant effect on fruit set, fruit, dry matter percentage, fruit soluble solid percentage, fruit ripening and yield of fruit crops. Incorporation of growth regulators is a common practice to improve the yield of apricot. If proper care is taken in spray by growth regulators such as GA_3 and NAA, the best quality and yield of apricot trees is assured.

MATERIALS AND METHODS

A field trial was conducted at Fruit Orchard, Department of Fruit Science, V. C. S. G Uttarakhand University of Horticulture and Forestry, Bharsar, Uttarakhand during 2014-2015. The experiment was laid out in Randomized Complete Block Design with nine treatments and three replications. The treatments were as follows: T1: GA_3 10 ppm, T_2: GA_3 15 ppm, T_3: NAA 10 ppm, T4: NAA 15 ppm, T5: GA_3 10ppm +NAA 10 ppm, T6: GA_3 15 ppm + NAA 15 ppm, T_7: GA_3 10 ppm + NAA 15 ppm, T_8: GA_3 15 ppm + NAA 10 ppm and T_9: control. The spray was applied at full bloom stage in February when the complete flowering was showed on trees. The required amount of PGR was weighted on an electronic digital balance separately, which was dissolved in 50 percent absolute alcohol. The GA_3 and NAA 40 and 60 mg single and combined dose were added to 4 liter of water then it will become 10 percent and 15 percent GA_3 and NAA. The spray solutions were prepared in proper concentrations and the final volume was made up with water. Treatment solutions were sprayed on the tree in the morning hours of the day in mist form.

RESULTS AND DISCUSSIONS

Fruit Set

The results of the present investigation (Table 1) revealed that a combined application of GA_3 10ppm +NAA 10 ppm increased the fruit set parameters of apricot trees when sprayed at full bloom stage. GA_3 10ppm +NAA 10 ppm gave the highest fruit set (60.59%) followed by GA_3 10 ppm (55.67%) and the lowest fruit set (21.38%) was obtained under control. Similar results were obtained by Shrama and Singh 2008, who found that all the treatments of growth regulators significantly increased the fruit set as compared to control. Findings of the present investigation are also nearly similar to the results of Decker's (1994).

Fruit Yield

Data presented in Table 2 revealed that GA3 10 ppm +NAA 10 ppm performed best with regard to the fruit yield, which gave highest fruit yield of 26.33 kg/tree followed by GA_3 10 ppm with 22.33 kg/tree fruit yield. Control with 10.66 kg fruit per tree obtained the last rank.

The above findings may be correlated with the observations made by Rizk *et al.*, 2006. Plant productivity is dependent upon the interaction between genetic potentialities of the crop plants and the environment in which they grow.

Table 1: Effect of GA3 and NAA on Fruit Set and Yield

Treatment	Fruit Set (%)	Fruit Yield (kg/tree)
Control	21.38	10.66
GA_3 10 ppm	55.67	22.33
GA_3 15 ppm	25.05	12.33
NAA 10 ppm	27.16	19.66
NAA 15 ppm	47.57	13.00
GA_3 10 ppm+NAA 10 ppm	60.59	26.33
GA_3 15 ppm +NAA 15 ppm	25.67	16.67
GA_3 10 ppm + NAA 15 ppm	37.67	15.00
GA_3 15 ppm + NAA 10 ppm	36.29	18.33
CD (0.05)	19.34	5.24

FRUIT QUALITY

Fruit Size

It is evident from the data of table 2 that, GA_3 10 ppm+NAA 10 ppm. The produced biggest fruits (4.15cm length and4.01cm diameter) which was found significantly superior over other treatments followed by GA_3 10 ppm (3.86×3.66 L×D). Smallest fruits (2.60 cm length and 2.07 cm diameter) were produced by the control. The above data are nearly similar to the findings of Negi and Sharma 2003, who reported that, application of NAA stimulate cell enlargement in the fruit mesocarp, which in turn, causes an improvement in fruit size and total yield (Stern *et al.,* 2007). Cleland, 1995 and Ranjan *et al.,* 2003 also reported that the increase in fruit size may be attributed to the increase in cell division and cell elongation caused by NAA and GA_3.

Fruit Weight

Maximum fruit weight was observed in GA_3 10 ppm+ NAA 10 ppm (35.45g) which was statistically at par with NAA 10 ppm (35.02g) and GA_3 10 ppm (29.36g). The minimum fruit weight was registered in the control (12.48g).

Table 2: Effect of GA3 and NAA on Fruit Quality

	Size (Cm)		Weight (Gm)	Volume (Cm^3)	Firmness (Kg/Cm^2)
	Length	Diameter			
Control	2.60	2.07	12.48	25.76	0.90
GA_3 10 ppm	3.86	3.66	29.36	31.44	1.17
GA_3 15 ppm	3.45	3.16	21.34	29.98	1.16
NAA 10 ppm	3.42	3.35	35.02	30.93	1.07
NAA 15 ppm	3.17	3.87	24.11	28.91	1.05
GA_3 10 ppm+NAA 10 ppm	4.15	4.01	35.45	32.05	1.26
GA_3 15ppm+NAA 15 ppm	3.24	3.45	24.24	29.37	1.05
GA_3 10 ppm + NAA 15 ppm	3.25	3.32	26.35	30.60	1.12
GA_3 15 ppm + NAA 10 ppm	2.65	2.79	23.47	30.90	1.14
CD (0.05)	0.62	0.45	7.5	1.20	0.11

Fruit Volume

A perusal of the data in Table 2 revealed that fruit volume in all treatment varied significantly when the spray was done at the full bloom stage. The highest fruit volume was obtained from GA_3 10 ppm+ NAA 10 ppm (32.05 cm^3 / fruit) followed by GA_3 10 ppm (31.44 cm^3 / fruit) and the minimum fruit volume was obtained from control (25.76 cm^3/fruit)

Results of the present study with regards to the fruit weight and volume are close conformity with the findings of Moore (1979) and Wasfy, (1995).

Fruit Firmness

Data on fruit firmness (Table 2) showed significant effect of different concentrations of GA_3 and NAA and revealed that the maximum firmness was obtained from GA_3 10 ppm + NAA 15 ppm (1.26 Kg/cm^2) which was found statistically at par with GA_3 15 ppm (1.16 kg/cm^2) and GA_3 10 ppm (1.17 kg/cm^2). The minimum firmness was recorded from the control (0.90 kg /cm^2). Increasing fruit firmness is one of the most frequent effects of preharvest GA_3, and NAA applications in fruit crops (Canli and Orhan, 2009; Kappel and MacDonald, 2002; Stern *et al.,* 2007; Usenik *et al.,* 2005). Results of the present study are more or less match with the findings of these scientists.

Total Soluble Solids

Total soluble solids showed considerable variations ranging from 16 ^{0}Brix to 21.0 ^{0}Brix, when growth regulators were sprayed at full bloom stage. The data show a significant effect with respect to total soluble solids. The maximum TSS was obtained from GA_3 10 ppm + NAA 10 ppm (21.00 ^{0}Brix) which was statistically at par with GA_3 10 ppm (20.00^{0}Brix). The minimum TSS obtained from control (16.00 ^{0}Brix) which was statistically at par with NAA15 ppm (17.00 ^{0}brix) and GA_3 15 ppm + NAA 10 ppm (17.00 ^{0}Brix) (Table 3). Results recorded by Sharma and Ananda (2004) nearly similar to the above findings. The results obtained in the present investigation were also found to be in close conformity with the studies of Fazli *et al.,* 2014.

Titratable Acidity

Titratable acidity considerably varied in all the treatments and showed a range of 0.67 % to 1.18%. The minimum titrable acidity was obtained from GA_3 10 ppm + NAA 10 ppm (0.67%) which was statistically at par with GA_3 10 ppm (0.71 %) and GA_3 10 ppm + NAA 15 ppm (0.73%) while, the maximum value was obtained in the control (1.18 %) which was significantly higher over the other treatments (Table 3). A similar result was found by Singh and Mishra (1986).

Ascorbic Acid

Data indicate that different concentrations of GA_3 and NAA was found significant, regarding to ascorbic acid content (Table 3). Mean values of ascorbic acid, revealed that treatment $GA_3$10 ppm + NAA 10 ppm possessed maximum ascorbic acid content (13.45 mg/100g) which was statistically at par with GA_3 10 ppm + NAA 15 ppm (10.07 mg/100g), GA_3 10 ppm (10.35 mg/100g) and NAA 10 ppm (10.30 mg/100 g). In contrast control possessed minimum quantity of ascorbic acid (9.03mg/100g). Similar observations were also recorded by Srivastava and Agrawal 1968 who reported that, such a variation in ascorbic acid in different apricot cultivars might be associated with the fruit maturity and the extent of genetic variability as well.

Total Phenol

Significant variation was found between the treatments with respect to the mean value of total phenol. The maximum value (0.07mg/100g) was recorded under GA_3 10 ppm+ NAA 10 ppm followed by GA_3 10 ppm with 0.06 mg/100g total phenols. The minimum phenol content was recorded under control (0.01mg/100g) (Table 3).

Table 3: Effect of GA3 and NAA on Fruit Quality

Treatment	T S S (^{0}Brix)	Titrable Acidity (%)	Ascorbic Acid (%)	Total Phenol	Total Sugar (%)	Reducing Sugar (%)	Non Reducing Sugar (%)
Control	16.00	1.18	9.03	0.01	13.81	2.11	11.11
GA_3 10 ppm	20.00	0.71	10.35	0.06	19.73	3.70	15.22
GA_3 15 ppm	18.00	0.91	9.95	0.05	18.14	2.77	14.60
NAA 10 ppm	16.00	0.97	10.30	0.04	15.93	3.46	11.84
NAA 15 ppm	17.00	0.98	9.92	0.03	15.53	3.08	11.82
$GA_3$10 ppm +NAA 10 ppm	21.00	0.67	13.45	0.07	21.22	4.27	16.10
GA_3 15 ppm+ NAA 15 ppm	19.00	0.85	10.07	0.03	18.26	3.25	14.23
GA_3 10 ppm + NAA 15 ppm	19.00	0.94	9.80	0.03	19.23	3.68	14.75
GA_3 15 ppm + NAA 10 ppm	17.00	0.73	9.82	0.05	15.80	3.21	11.96
CD (0.05)	1.729	0.158	2.203	0.020	0.883	0.586	0.685

Total Sugars

In the present study total sugars of fruits considerably varied from 13.81 % to 21.11% (Table 3). The fruits treated with GA_3 10 ppm + NAA 10 ppm were experienced to be the sweetest and contained highest total sugars (21.22%) followed by GA_3 10 ppm (19.73 %). The minimum (13.81 %) sugar was obtained from control.

Reducing Sugars

Data on reducing sugar presented in Table 3. The data show that the different concentrations of GA_3 and NAA have a significant effect on reducing sugar. Data regarding reducing sugar content in fruits indicate that GA_3 10 ppm+ NAA 10 ppm treatment had maximum reducing sugar content (4.27%) which was statistically at par with GA_3 10 ppm (3.70%) and GA_3 10 ppm + NAA 15 ppm (3.70%). Minimum reducing sugar was recorded in the control 2.11%.

Non-reducing Sugars

In all the treatments studied, non-reducing sugars considerably found significant and showed a range of 11.11 % to 15.69 %. Maximum non-reducing sugar was obtained in $GA_3$10 ppm + NAA 10 ppm (16.10 %) which was statistically at par with GA_3 10 ppm (15.22%) and significantly higher over other treatments. Treatment control had minimum non-reducing sugar content (11.11%) (Table 3) These findings are in conformity with the results recorded by Westwood (1993).

CONCLUSIONS

From the present investigation, it is concluded that among various concentrations of GA_3 and NAA, GA_3 10 ppm + NAA 10 ppm and GA_3 15 ppm + NAA 10 ppm performed the best in terms of percentage of fruit set, fruit yield and quality when sprayed at full bloom stage.

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